Rewarding Learning

General Certificate of Secondary Education
2012

# Science: Chemistry

Paper 2
Higher Tier

**[G1404]**

**FRIDAY 22 JUNE, AFTERNOON**

# MARK SCHEME

| | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|
| **1** | **(a)** | **(i)** | iron | [1] | |
| | | **(ii)** | oxygen | [1] | |
| | | **(iii)** | water | [1] | |
| | | **(iv)** | gain of oxygen | [1] | |
| | | **(v)** | red-brown [1] flaky [1] solid [1] | maximum [2] | |
| | **(b)** | **(i)** | $H_2 + Cl_2 \rightarrow 2HCl$ | [3] | |
| | | **(ii)** | chlorine gains hydrogen [1]<br>gain of hydrogen is reduction [1] | [2] | |
| | | **(iii)** | chlorine: yellow-green [1]<br>hydrogen: colourless [1] | [2] | |
| | | **(iv)** | gives out heat | [1] | |
| | **(c)** | **(i)** | thermal [1] decomposition [1] | [2] | |
| | | **(ii)** | $CuCO_3 \rightarrow CuO + CO_2$ | [2] | |
| | | **(iii)** | green [1] to black [1] | [2] | |
| | **(d)** | **(i)** | sulphate | [1] | |
| | | **(ii)** | magnesium | [1] | |
| | | **(iii)** | $Mg \rightarrow Mg^{2+} + 2e^-$ | [3] | |
| | | **(iv)** | (copper ions) gain electrons [1]<br>gain of electrons is reduction [1] | [2] | 27 |

**2** **(a)** moles of carbon = $\frac{72}{12}$ = 6 [1]

moles of hydrogen = $\frac{13.2}{1}$ =13.2 [1]

moles of nitrogen = $\frac{16.8}{14}$ =1.2 [1]

moles of oxygen = $\frac{38.4}{16}$ = 2.4 [1]

$C_5H_{11}NO_2$ or ratio: C:H:N:O = 5:11:1:2 [1] [5]

**(b)** **(i)** $\frac{20 \times 0.125}{1000}$ [1] = 0.0025 [1] [2]

**(ii)** $\frac{0.0025}{2}$ [1] = 0.00125 [1] [2]

**(iii)** 0.00125 × 40 (**or** $\frac{0.00125 \times 1000}{25}$) [1] = 0.05 [1] [2]

**(iv)** $\frac{3.7}{0.05}$ [1] = 74 [1] [2]

**(v)** 74 – 60 = 14/2 = 7 [1]
lithium/$Li_2CO_3$/Li [1] [2]

**(c)** mass of $NH_4NO_3$ = 2000 g [1]

RFM of $NH_4NO_3$ = 80 [1]

moles of $NH_4NO_3$ = $\frac{2000}{80}$ = 25 [1]

moles of $N_2O$ = 25 [1]
25 × 24 [1] = 600 [1] $dm^3$ [6]

**(d)** **(i)** equal volumes of gases [1]
under the same conditions of temperature and pressure [1]
contain the same number of particles [1] [3]

**(ii)** 70 × 2 [1] = 140 [1] $cm^3$ [2]

AVAILABLE MARKS

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AVAILABLE MARKS

**3** **(a)** **(i)**

| Substance | acid | base | alkali | salt |
|---|---|---|---|---|
| magnesium chloride | | | | ✓ [1] |
| magnesium hydroxide | | ✓ [1] | | |
| sodium hydroxide | | ✓ | ✓ | |
| | accept either tick for sodium hydroxide [1] | | | |
| zinc sulphate | | | | ✓ [1] |

[4]

**(ii)** $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ [3]

**(iii)** magnesium nitrate [1]

**(iv)** contains water [1]
contains water of crystallisation [2] [2]

**(b)** **(i)** pipette [1]

**(ii)** pink [1] to colourless [1] [2]
[1] if wrong way round

**(iii)** remove the indicator [1]

**(iv)** Individual marks are awarded for correctly labelled and recognisable drawings of assembled apparatus.
No labels = no marks.

evaporating basin [1]
tripod and gauze [1]
heat/Bunsen burner [1] [3]

**(v)** solubility decreases/solution becomes saturated [1]

**(vi)** any **one** from:
dry between two sheets of filter paper [1]
dry in a low temperature oven [1]
dry in a desiccator [1] [1]

**(c)** **(i)** negative ion [1]

**(ii)** solid [1] appearing when two solutions are mixed [1] [2]

**(iii)** barium chloride/barium nitrate [1]

**(iv)** yellow [1] 24

**4** **(a)** decomposition/breaking down [1]
of a substance using electricity [1] [2]

**(b)** bauxite [1]

**(c)** **(i)** A is anode [1]
B is cathode [1]
C casing [1]
D is (molten) aluminium [1] [4]

**(ii)** ions are free to move [1]
idea that ions are charge carriers [1] [2]

**(iii)** 900–1000 °C [1]

**(iv)** lower melting point (of aluminium oxide)/increase conductivity [1]

**(v)**

| | **Positive electrode** | **Negative electrode** | |
|---|---|---|---|
| Name of product | oxygen [1] | aluminium [1] | [2] |
| Half equation | $2O^{2-} \rightarrow O_2 + 4e^-$ [3] | $Al^{3+} + 3e^- \rightarrow Al$ [3] | [6] |

**(vi)** electrode: anode [1]
equation: $C + O_2 \rightarrow CO_2$ [2]

**(vii)** aluminium is tapped off [1] at the bottom of the cell [1]

AVAILABLE MARKS

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| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| **5** | **(a)** | anaerobic (decay) [1]<br>of dead plants and animals [1]<br>over millions of years [1]<br>under the action of (heat and) pressure [1] | maximum [3] | |
| | **(b)** | **(i)** any **two** from:<br>creates employment<br>local/cheap fuel supply<br>benefits local economy<br>improved transport links | [2] | |
| | | **(ii)** any **two** from:<br>eyesore<br>destroys habitats<br>dust pollution<br>noise pollution<br>depletion of resources | [2] | |
| | **(c)** | **(i)** soluble in water | [1] | |
| | | **(ii)** heating water/evaporate salt solution | [1] | |
| | | **(iii)** subsidence/landslides | [1] | |
| | **(d)** | **(i)** electrolysis | [1] | |
| | | **(ii)** NaOH | [1] | |
| | | **(iii)** chlorine: bleach/PVC manufacture/water sterilisation [1]<br>hydrogen: rocket fuel/weather balloons [1] | [2] | 14 |

AVAILABLE MARKS

**6 (a)**

| Gas | Test | Result of positive test | |
|---|---|---|---|
| carbon dioxide | bubble into **limewater** [1] | milky [1] | [2] |
| hydrogen | apply a lit splint [1] | pop [1] | [2] |
| hydrogen chloride | glass rod dipped in **concentrated** [1] **ammonia** [1] | white [1] smoke [1] | [4] |

**(b) (i)** $SO_2 + H_2O \rightarrow H_2SO_3$ [2]

**(ii)** any **two** from:
corrodes statues/buildings [1]
kills fish [1]
kills trees/ vegetation [1] [2]

**(c) (i)** correct colour of sugar [1]
crystalline [1]
solid [1] maximum [2]

**(ii)** sugar (initially) goes brown [1]
swells/rises up beaker/pillar [1]
reaction not immediate [1]
heat released [1]
caramel smell [1]
pungent odour [1]
gas/vapour/hisses/bubbles/porous solid/steamy fumes [1]
black [1] solid remains maximum [3]

**(d) (i)**

| | Result of a positive test when ammonia solution is added |
|---|---|
| iron(II) ion | green [1] ppt [1] |
| iron(III) ion | red-brown/brown [1] ppt [1] |

[4]

**(ii)** $Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$ [3]

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| | AVAILABLE MARKS |
|---|---|

**7** **(a)** Individual marks are awarded for correctly labelled and recognisable drawings of assembled apparatus which will work.
No labels = no marks.

reaction vessel [1]
delivery tube [1]
*sealed system [1]
gas syringe [1]
stopclock [1]
* = essential mark maximum [4]

**(b)** **(i)** substance that speeds up [1]
a (chemical) reaction [1]
without being used up [1] [3]

**(ii)** 1g [1]

**(iii)**

| Industrial Process | Catalyst used | Balanced symbol equation for the catalysed reaction |
|---|---|---|
| The Haber Process | iron | $\mathbf{N_2 + 3H_2 \rightarrow 2NH_3}$ [3] |
| The Contact Process | **vanadium(V) oxide/ vanadium pentoxide/ $\mathbf{V_2O_5}$** [1] | $2SO_2 + O_2 \rightarrow 2SO_3$ |
| Production of Nitric acid | platinum/ rhodium | $\mathbf{4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O}$ [3] |

**(c)** particles gain energy/move faster [1]
more successful collisions [1]
in a given period of time/idea of frequency [1] [3]

Quality of written communication [2]

**(d)** any **two** from:
vessels to contain high pressure expensive
high pressure dangerous/safety
reduce risk of explosion [2] 22

**Total** **160**